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Enclosure 2 to Our Letter of July 2, 2004

International Application PCT/EP0308884 - 2710-S PCT

PRESSURE REGULATOR MODULE FOR A MOTOR VEHICLE PNEUMATIC BRAKING SYSTEM

Specification

State of the Art

The invention relates to a pressure regulator module for a motor vehicle pneumatic braking system, particularly of a utility vehicle, for the wheel-slip-dependent controlling or regulating of braking pressures applied to two separate working connections, and comprising a two-way valve assembly having one relay valve for each conduit, one solenoid control valve respectively being assigned to the control inputs of each of the two relay valves, according to the preamble of Claim 1.

Such pressure regulator modules are used for controlling and regulating the braking pressure at the vehicle wheels in order to prevent a locking during a braking (antilock system, ABS) or a wheel slip during an accelerating operation (wheel slip control system, ASR). Known antilock systems consist of wheel speed sensors, an electronic controlling and regulating unit as well as

the pressure regulator modules. In this case, each individually regulated wheel requires a wheel speed sensor and a pressure regulator module as well as a connection to the electronic controlling and regulating unit. The ASR uses the same structural members as the ABS but beyond that has an additional valve for building up braking pressure at a spinning wheel independently of the operation of the brake pedal. The wheel-related wheel speed sensor is arranged on the respective vehicle wheel in order to measure the momentary wheel speed and sends a corresponding electrical signal to the controlling and regulating unit which analyzes the signals received from the wheel speed sensors of the additional vehicle wheels as well as other parameters, such as the vehicle speed and the vehicle acceleration and decides whether one or more wheels slip beyond defined values during braking or accelerating. For avoiding an excessive wheel slip, the pressure regulator modules of the controlling and regulating unit are then controlled in order to reduce, increase or maintain the braking pressure in the concerned vehicle wheels. Furthermore, it is known to combine the pressure modulator modules of the wheel of one axle or of one axle side to a single, multi-conduit pressure regulator module in order to save components and installation space.

A 2-conduit pressure regulator module of the above-mentioned type is known from German Patent Document DE 42 27 084 A1, in

which case, according to a first embodiment of the citation, a wheel-slip-dependent regulating of the braking pressure is provided in the event that the wheels of one axle lock during the braking (ABS). The valve unit in each case comprises a solenoid control valve in the form of a 2/2-way valve which is assigned to a relay valve and either blocks the control input of the assigned relay valve or connects it with the output of a bleeder valve connected in front of it, which bleeder valve is connected on the input side with a control pressure and with a bleeding system. Since only one bleeder valve is present, a pressure buildup or pressure reduction, which in each case acts only in the same direction, can take place in the two brake cylinders, while pressure changes in the opposite direction, such as a pressure buildup in one brake cylinder and a pressure reduction in the other brake cylinder, cannot take place. By way of a respective shutting of the 2/2-way valves, however, different braking pressures can be controlled. A total of three solenoid control valves are therefore provided for controlling the two relay valves.

According to another embodiment of the citation, a pressure regulator module is disclosed which, in addition to the ABS during the braking, has an ASR which prevents the slipping of the wheels when starting or accelerating. According to this embodiment, five solenoid control valves are present for controlling the two relay valves.

U.S. Patent Document US 6,371,573 B1 discloses a single-conduit braking system, in which a relay valve is controlled by a 3/2-way valve.

It is an object of the present invention to further develop a pressure regulator module of the initially mentioned type such that, while its functionality is high, it can be produced in a simple and cost-effective manner.

According to the invention, this object is achieved by means of the characterizing features of Claim 1.

Advantages of the Invention

As a result of the corresponding controlling of the two 3/2-way control valves, the braking pressure at the working connections in the sense of a wheel-related ABS system can be individually reduced, maintained or raised. In addition to the ABS, a wheel slip control system (ASR) can also be implemented. With respect to an embodiment of German Patent Document DE 42 27 084 A1, which also contains wheel-individual ABS and ASR functions, however, instead of five solenoid control valves, only three are provided. The invention therefore offers savings with respect to the installation space, the weight and the cost.

In addition, by means of this valve arrangement according to the invention, an expanded ABS can also be implemented, in which

the vehicle stability is increased also without the presence of a braking initiated by the driver by the wheel-individual automatic controlling-in of braking pressure in order to prevent, for example, during a cornering, by means of a targeted braking, a lateral rolling-over of the vehicle. Furthermore, in both cases the cabling expenditures are also lower. In addition, because of the lower number of solenoid control valves, fewer drivers or interfaces are required.

The used 3/2 valves are simply constructed solenoid control valves, in the case of which, by way of 2 control positions, a pressure in the sense of a 2-way function can either be built up or reduced. Relative to the controlling of the relay valves, this means that, for example, in the unexcited condition of the 3/2-way valve, a control pressure is switched through unchanged to the control connection of the assigned relay valve and, in the excited case, the control connection of the relay valve is connected with a bleeding connection while the control pressure is simultaneously blocked. By means of a special electric control mode, in addition to the pressure buildup and the pressure reduction, a pressure-holding function can be implemented, for example, in that, for holding the pressure, the electronic control system controls the 3/2-way control valves at a higher frequency and with a corresponding timing ratio (switch-on to switch-off time). As a result, the control pressure of the relay valve is also timed, in which case the relay control piston

remains in its center position because of its hysteresis and therefore in the holding function. As a result, with respect to the controlling electronic control system, only a simple electric switching function of the current is required, for example, by way of a simple electronic switching transistor and no high-expenditure regulating of current as in the case of a proportional valve according to another embodiment of German Patent Document DE 42 27 084 A1.

Relative to the extent of the functions, the invention therefore achieves the implementation of a pressure regulator module with few and with cost-effective control valves respectively.

As a result of the measures indicated in the subclaims, advantageous further developments and an improvement of the invention indicated in Claim 1 can be achieved.

According to a preferred embodiment of the invention, the two 3/2-way valves are controlled independently of one another by an electronic controlling and regulating unit and, on the input side, are connected with the control pressure and, on the output side are connected in each case with the control input of the assigned relay valve and with the bleeding system.

In a preferred further development, in the non-energized

spring-loaded normal position, the two 3/2-way valves switch the control pressure through to the control inputs of the relay valves and, in the energized position, switch the control inputs of the relay valves through to the bleeding system.

In a particularly preferable manner, for keeping the pressure at the working connection of the respective conduit, the assigned solenoid control valve is alternately switched back and forth into the pressure buildup and pressure reduction position by means of the controlling and regulating unit. As a result of the briefly alternating pressure buildup or pressure reduction, a quasi-constant pressure is reached in a brake cylinder connected with the corresponding working connection without requiring additional measures or components for this purpose.

According to particularly preferable measures, the additional solenoid control valve is formed by another 3/2-way valve which is controlled by the electronic controlling and regulating unit and which is connected on the input side with the control pressure and on the output side with the inputs of the two solenoid control valves and with the compressed-air reservoir. In the non-energized spring-loaded normal position, the additional solenoid control valve can then switch the control pressure through to the inputs of the two solenoid control valves and, in the energized position, can switch the inputs of the two solenoid control valves through to the compressed-air reservoir.

In particular, the additional solenoid control valve is operated independently of the control pressure and as a function of a wheel slip occurring during the acceleration by means of the regulating and controlling unit. Independently of an operation of the service brake valve, the brake cylinders can therefore be acted upon by pressure from the compressed-air reservoir in order to avoid a spinning during an accelerating operation, whereby the automatic wheel slip control is implemented.

The additional solenoid control valve is preferably integrated in a housing accommodating the valve unit. Furthermore, the additional solenoid control valve may be arranged outside the housing accommodating the remaining valve unit consisting of the two relay valves and the assigned solenoid control valves and can be constructed to be connectable thereto. In this case, it is conceivable to retrofit a pressure regulator module according to the first alternative of the invention comprising only the antilock function in a simple and rapid manner such that it additionally comprises an automatic slip control. This results in a cost-effective modular design since, based on a basic module consisting of two relay valves and two solenoid control valves, pneumatic braking systems with an ABS function as well as those with an ABS and an ASR function can be implemented.

The center axes of the two relay valves of the valve unit

are preferably arranged coaxially and horizontally. This permits a very compact type of construction with only a single central bleeding connection.

Drawings

Embodiments of the invention are illustrated in the drawing and will be explained in detail in the following description.

Figure 1 is a schematic representation of a 2-conduit pressure regulator module of the invention according to a preferred embodiment;

Figure 2 is a braking pressure - time diagram for illustrating an antilock braking system having the pressure regulator module of Figure 1;

Figure 3 is a schematic representation of a 2-conduit pressure regulator module of the invention according to another embodiment;

Figure 4 is a diagram for illustrating a wheel slip control system having the pressure regulator module of Figure 3;

Figure 5 is a schematic representation of a 2-conduit pressure regulator module of the invention according to another embodiment.

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CLAIMS:

1. Pressure regulator module (1) for a vehicle pneumatic braking system, particularly of a utility vehicle, for the wheel-slip-dependent controlling or regulating of braking pressures applied to two separate working connections (30, 32), and comprising a two-conduit valve unit (2) having one relay valve (6,8) for each conduit (A,B), characterized in that, without the insertion of additional valves, in each case, a solenoid control valve (10, 12) constructed as a 3/2-way valve (10, 12) with two switching positions is assigned to the control inputs (14, 16) of each of the two relay valves (6, 8), and the solenoid control valves (10, 12), together with only one additional solenoid control valve (76) connected on the input side, connect the control input (14, 16) of the respective relay valve (6, 8) with the bleeding system (28), with a control pressure (80) or with a compressed-air reservoir (22).

2. Pressure regulator module according to Claim 1, characterized in that the two solenoid control valves (10, 12)

are controlled independently of one another by an electronic controlling and regulating unit (72), and are connected on the input side with the control pressure (54) and on the output side, in each case, with the control input (14, 16) of the assigned relay valve (6, 8) and with the bleeding system (28).

3. Pressure regulator module according to Claim 2, characterized in that, in the non-energized spring-loaded normal position, the solenoid control valves (10, 12) switch the control pressure (54) through to the control inputs (14, 16) of the relay valves (6, 8) and, in the energized position, switch the control inputs (14, 16) of the relay valves (6, 8) through to the bleeding system (28).

4. Pressure regulator module according to Claim 3, characterized in that, for holding the pressure at the working connection (30,32) of the respective conduit (A, B), the assigned solenoid control valve (10, 12) is alternatingly switched back and forth in the pressure buildup position and the pressure reduction position by means of the controlling and regulating unit (72).

5. Pressure regulator module according to one of Claims 2 to 4, characterized in that the additional solenoid control valve (76) is formed by an additional 3/2-way valve which is controlled by

the electronic controlling and regulating unit (72) and which is connected on the input side with the control pressure (80) and with the compressed-air reservoir (22), and on the output side with the inputs (50, 52) of the two solenoid control valves (10, 12).

6. Pressure regulator module according to Claim 5, characterized in that, in the non-energized spring-loaded normal position, the additional solenoid control valve (76) switches the control pressure (80) through to the inputs (50, 52) of the two solenoid control valves (10, 12) and in the energized position, switches the inputs (50, 52) of the two solenoid control valves (10, 12) through to the compressed-air reservoir (22).

7. Pressure regulator module according to Claim 6, characterized in that the additional solenoid control valve (76) is operated independently of the control pressure (80) and as a function of a wheel slip occurring during an acceleration or of the lateral acceleration.

8. Pressure regulator module according to Claim 7, characterized in that the additional solenoid control valve (76) is integrated in a housing (78) accommodating the valve unit (2).

9. Pressure regulator module according to Claim 8, characterized in that the additional solenoid control valve (76)

is arranged outside a housing (78) accommodating the remaining valve unit (2) consisting of the two relay valves (6,8) and the assigned solenoid control valves (10, 12), and is constructed to be connectable to this valve unit (2).

10. Pressure regulator module according to one of the preceding claims, characterized in that the center axes of the two relay valves (6, 8) are arranged coaxially and horizontally.

11. Pressure regulator module according to one of the preceding claims, characterized in that an acceleration sensor is provided for detecting the lateral acceleration, which sensor is preferably integrated in the electronic unit (4).

AMENDED PAGE